SILICA in NOVA SCOTIA

by

R. H. MacDonald

INFORMATION CIRCULAR
14

88-04158/

Cover Photo: Nova Scotia Sand and Gravel silica sand plant, Shubenacadie, Hants County (courtesy of N.S. Sand and Gravel).

SILICA
in
NOVA SCOTIA

by
R.H. MacDonald

Information Circular
14

Nova Scotia Department
of Mines and Energy
Halifax, Nova Scotia
1988

SILICA

Introduction

Silicon is the most abundant element on the earth's surface and in the form of silica is consumed in a great number of industrial uses. Silica occurs both in rock and granular forms with deposits common throughout most areas of Nova Scotia. Silica rock occurrences with economic potential are found in quartzites of the Precambrian age, George River Group on Cape Breton Island. Orthoquartzites of Silurian-Devonian age found in the White Rock Formation of southwestern Nova Scotia also exhibit excellent potential for economic development. Quartz veins with economic potential occur within Cambro-Ordovician age rocks of the Meguma Group which comprise 16 317 km^2 of the southern portion of mainland Nova Scotia. High silica content sandstones with economic potential occur in Early Carboniferous age rocks belonging to the Horton Group and occur in central and northern Nova Scotia.

Granular deposits of white silica sand of Cretaceous age occur in Windsor Group fault bound basins in the Shubenacadie, Musquodoboit

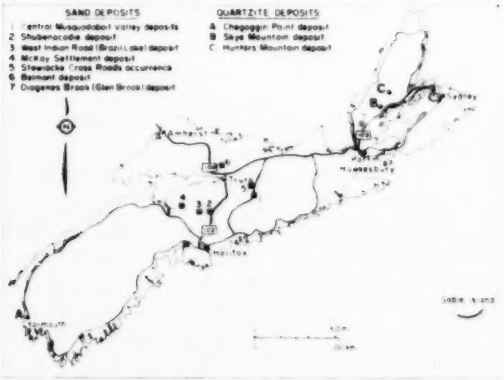

Figure 1. Location of major silica sand and quartzite deposits in Nova Scotia.

and Stewiacke Valleys on mainland Nova Scotia and at Diogenes (Glen) Brook, Cape Breton Island, and in isolated sinkholes and unconformity fillings within or adjacent to Windsor Group carbonate rocks. Other granular deposits are found as ice contact deposits throughout the Province and beach deposits along the coast.

USES OF SILICA

Silica has many industrial applications in abrasives and polishes, in glass manufacture, fillers and extenders, silica brick manufacture, as a catalyst, in specialty coatings, cleansers, ceramics, electronics, optics, and refractories, in ferro-silicon manufacture, rubber, and as a frac sand.

Processing of silica of specific quality yields several types of specialty silicas. These include colloidal, fumed, fused, high purity ground, silica gel, and precipitated silica.

Colloidal silica is mainly used as a high temperature binder for silicon wafer polishing and carbonless paper. Fumed silica because of its unique strength, thixotropic properties and flatting properties, is a valuable ingredient in rubber, plastics, specialty coatings, adhesives, and sealants manufacturing, pesticides, cosmetics, pharmaceuticals, defoamers, inks, abrasives and batteries.

Fused silica is produced by fusion of very high quality silica sand feedstock in electric arc and resistance furnaces. The resulting product is very different from the original silica sand due to the extremely high quality, consistent chemistry, high resistance to thermal shock and low thermal conductivity. It is therefore suitable as a filler for electronic encapsulants, refractory and investment castings and specialty coatings.

High purity ground silica is produced from silica sand or soft, friable rocks and is often referred to as amorphous silica. It is used mainly in specialty coatings, plastics, rubber, electronics, abrasives, refractories and optics depending on average particle size, distribution, hardness and refractive index.

Silica gel is an extremely pure, porous, and amorphous form of silica known for a high degree of internal surface area, hardness, uniformity and chemical inertness. Its ability to absorb liquids makes it valuable in a wide variety of

applications including catalysts, anticaking agents in food and pharmaceutical products, desiccants, cosmetics, plastics, specialty coatings, paper and adhesives.

Precipitated silica is another type of specialty silica which is mainly used as a reinforcing agent in tire compounds. Its properties also provide anticaking, conditioning, suspension, and viscosity control in products like tooth pastes, deodorants, nail polishes and vitamin tablets.

Current prices for the various forms of these specialty silicas range from $140 (Cdn.) per t to nearly $6600 (Cdn.) per t.

In the past, Nova Scotia silica resources have been exploited for use in silica brick manufacture, glass making, blasting sand, frac sand and molding sand. There exists within Nova Scotia, deposits of high grade silica that can fulfil most of the applications discussed above and many of these deposits are large enough and suitably located to make development economically feasible.

QUARTZITE

There are many occurrences of quartzite throughout Nova Scotia and many grades are available. Quartzite is a metamorphosed sandstone made up chiefly of quartz sand united by a siliceous cement to form hard, low porosity rock. The colour of Nova Scotia quartzite varies from white to grey with a few occurrences tinted various shades of brown, red or yellow due to the presence of small amounts of impurities.

There are some extremely high grade silica rich quartzite deposits in Nova Scotia with SiO_2 values in the > 99 per cent range. The most notable of these occurs in the Silurian-Devonian age White Rock Formation and outcrops along the coastline at Chegoggin Point, Yarmouth County. This deposit was previously quarried from 1947 to 1963 by Dominion Steel Corporation and used as raw material for the manufacture of silica bricks which were used at their steel plant at Sydney, Nova Scotia. During the life of the quarry, approximately 100 000 t of silica was extracted on a seasonal basis. The silica ore far exceeded specifications for silica brick manufacture with SiO_2 percentages consistently over 99 per cent. The deposit consists of wide beds of

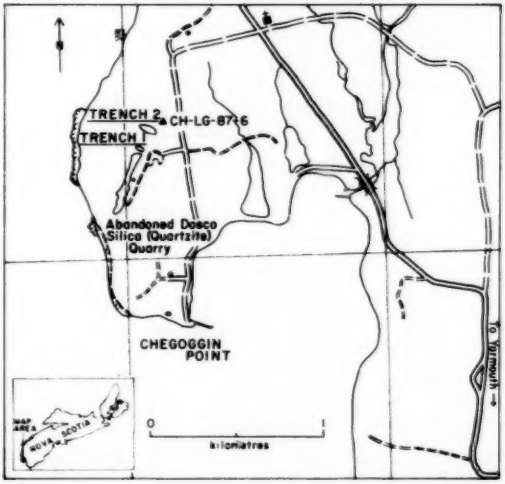

Figure 2. Location map of Chegoggin Point high grade silica and garnet deposit showing abandoned quarry, recent exploration trenches and diamond drill hole CH-LG-87-6.

orthoquartzite contained within a metasedimentary and metavolcanic sequence. The quartzite is fused, extremely hard and has been injected with veins of pure secondary quartz. The beds are lenticular and pinch and swell along strike. A recent diamond-drill hole (CH-LG-87-6) near the coastline intersected quartzite beds with a total thickness in excess of 61 m. A crosssection of this drillhole is shown in Figure 3. The quartzite beds appear to be discontinuous and displaced at locations along strike, but a previous drillhole did intersect similar quartzite beds with a total thickness in excess of 60 m, 16 km northeast on the western shore of Lake George, Yarmouth County. It is estimated that a reserve in excess of 9 million t of high grade silica occurs in steeply dipping beds of quartzite which extend inland from Chegoggin Point approximately 5 km. Shipping possibilities for this material are enhanced by the availability of 12 m of tidewater at Chegoggin Point. Chemical analysis of this deposit appears in Table 1. Associated with the silica beds are beds of garnet-schist containing 4050 per cent almandine garnets over widths of 3.5-4.5 m. Preliminary tests indicate that the garnets are of excellent abrasive quality.

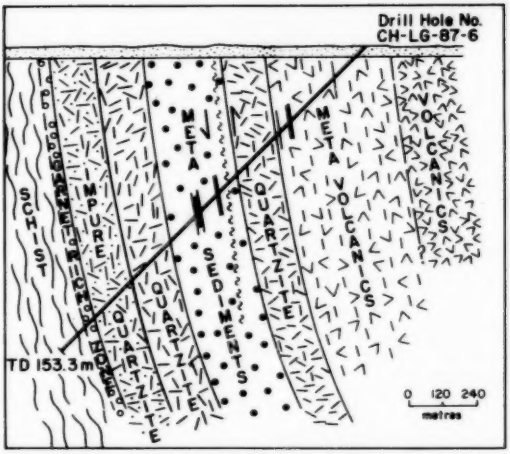

Figure 3. Cross-section of drill hole CH-LG-87-6 through high grade silica quartzite beds at Chegoggin Point, Yarmouth County.

Quartzite of the White Rock Formation extends intermittently from Chegoggin Point, Yarmouth County to New Minas, Kings County, a distance of over 200 km. The SiO_2 content of the quartzite is 96-97 per cent at White Rock, Kings County, where the quartzite is quarried and crushed and used to make "tilt-up" building panels which are used in construction of many decorative buildings throughout Nova Scotia.

On Cape Breton Island, high silica quartzite occurs in the Precambrian age George River Group metasedimentary rocks at Skye Mountain, Inverness County and at Hunters Mountain, Victoria County. A high grade quartzite deposit at Leitches Creek, Cape Breton County was quarried by Dominion Steel Corporation in the early 1900s as a source of material for silica brick for the nearby steel works at Sydney. This operation was seasonal and depended on the demand by the steel plant.

Silica deposits discussed above and others with potential that have been largely unexplored to date are listed in Table 1 along with chemical analysis where available.

Table 1. Chemical analysis of selected, high potential si ca de, sits throughout Nova Scotia.

Deposit Location	Type	%							
		SiO_2	A_2O_3	Fe_2O_3	CaO	MgO	MnO	S	TiO_2
Chegoggin Point, Yarmouth County	Quartzite (white)	99.70 99.60	0.12 0.082	0.25 0.35	0.012 0.018	< 0.002 < 0.002	0.002 0.002	0.024 0.02	n/a n/a
	Quartzite (dark brown)	98.82	0.[illegible]	0.33	0.014	0.007	0.003	0.024	n/a
White Rock Mills, Kings County	Quartzite (white to pale yellow to pale brown)	90.70 95.01	0.1[illegible] 2.2[illegible]	3,24 1.77	2.03 nil	2.11 niil	nil 0.13	n/a n/a	n/a n/a
Diogenes Brook, Inverness County	Sand (over 27 m) Sand (over 18 m)	96.51 96.77	1.27 1.22	0.81 0.75	n/a n/a	n/a n/a	n/a n/a	0.05 0.02	0.10 0.08
Leitches Creek, Cape Breton County	Quartzite	97.22	1.75	0.40	0.30	0.18	n/a	n/a	n/a
George River, Cape Breton County	Quartzite	96.91	0.66	1.36	0.12	0.27	n/a	n/a	n/a
Aberdeen, Inverness County	Sandstone	96.09	2.15	0.49	0.10	0.38	n/a	n/a	n/a
Skye Mountain, Inverness County	Quartzite	97.37	1.34	0.48	0.12	0.11	n/a	n/a	n/a
Iron Mines, Inverness County	Quartzite	97.66	1.[illegible]9	0.40	0.10	0.20	n/a	n/a	n/a
Shubenacadie, Hants County	Sand Sand	98.80 98.76	0.[illegible] 0.[illegible]	0.20 0.20	0.04 0.04	0.03 0.03	n/a n/a	n/a n/a	0.37 0.37
Hantsport, Kings County	Sandstone	96.1	1.[illegible]	0.78	n/a	n/a	n/a	n/a	n/a

QUARTZ VEINS

Quartz is the most common mineral in Nova Scotia's gold districts making up 20-30 per cent by volume in some deposits. The quartz veins reach widths in excess of 6 m at certain locations and are extremely high grade, massive, colourless to white and range from semitransparent to opaque. Wide quartz veins of this type are known to occur within the Meguma Group terrane in southwestern Nova Scotia at Caledonia, Queens County, Little Tobeatic Lake, Shelburne County and Flintstone Rock, Yarmouth County. They also occur near Country Harbour, Guysborough County in eastern Nova Scotia where SiO_2 values in the veins are in the 98-99 per cent range. More quartz veins similar to those described occur at other locations within Meguma terrane.

SANDSTONES

High silica sandstone deposits are found in Early Carboniferous rocks of the Horton Group. The deposit with the best potential for development is located just north of Hantsport, Kings County. Previous diamond drilling has indicated a reserve of 100 000 t grading 96.1 per cent SiO_2. Other known Horton Group sandstone deposits with SiO_2

percentages in the 83-85 per cent range are located near McKinnon Lake, Willowdale and Lansdowne Station in Pictou County and near Sutherland Brook, Colchester County.

SILICA SAND

High purity (> 98 per cent SiO_2) silica sand suitable for manufacturing glass bottles, fibreglas insulation and sand blasting occurs in many locations in Nova Scotia. The most notable deposits occur as sinkhole and fault bound Windsor Basin fillings in the Musquodoboit and Shubenacadie Valleys and at Diogenes Brook (Glen Brook), Inverness County. Present silica sand production is from the West Indian Road, Hants County deposit and from the Elmsvale deposit in the central Musquodoboit Valley. The West Indian Road deposit is a sinkhole filling comprised chiefly of sand and has been producing for many years. The Musquodoboit Valley deposits tend to be lenticular and thin within the Cretaceous section which is comprised of interbedded silica sand and kaolinitic clay.

The silica sand deposit on Diogenes Brook, Inverness County, is located 3.2 km northwest of the community of Melford. The deposit was worked during the late 1920s by the River Denys Sand and Clay Company, but little evidence of the old operations remains. Access to the site is provided by a logging road along the western side of Diogenes Brook from Highway 105 at Melford, Inverness County.

The silica sand was initially exposed in the Diogenes Brook stream bed which is constrained by steep, 95 m high, valley walls that are covered with thick deposits of glacial till and talus. The sand is now visible in old excavations near the intersection of the two main tributaries of Diogenes Brook where up to 20 m thick deposits of ice contact stratified drift occur. The top of the silica sand appears to be flat lying and is approximately 5 m above the present stream level. The sand does not occur as high terraces on either side of the stream valley and as a consequence only the top 5 m of the deposit could be removed above the water table.

Three diamond-drill holes were collared in the deposit by the Nova Scotia Department of Mines and Energy in 1982, two to test the thickness of overburden and one to determine the thickness of the

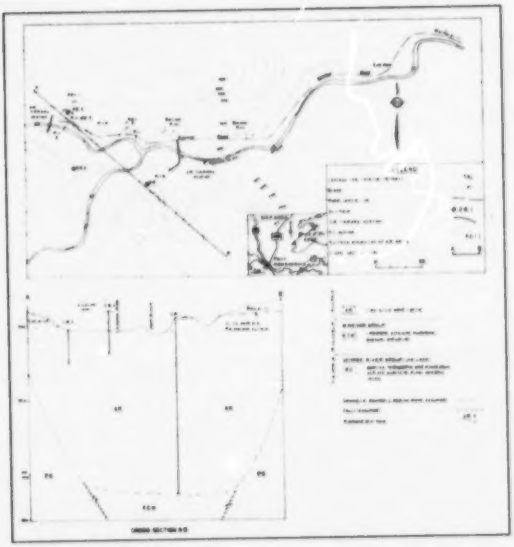

Figure 4. Plan and cross-section of Diogenes Brook silica sand deposit. (after Dickie, 1986).

deposit itself. The deposit consists of interbedded coarse and fine white sand and clay. It is 125 m thick and overlies a white limestone breccia. On the surface, bedding planes strike 180 and dip 40 east. Analyses of sand samples collected during drilling indicated a possible 7 million t of > 95 per cent SiO_2 is present in the Diogenes Brook deposit.

MINERAL RIGHTS

In Nova Scotia, silica is designated a Crown mineral and therefore mineral rights must be applied for and granted on behalf of the Province of Nova Scotia by the Department of Mines and Energy through an exploration license.

SELECTED BIBLIOGRAPHY

Dickie G. B., 1986: Cretaceous deposits of Nova Scotia; Nova Scotia Department of Mines and Energy, Paper 86-1.

MacDonald, R. H., in press: Chegoggin Point to Lake George high grade silica and garnet deposit; Nova Scotia Department of Mines and Energy, Open File Report.

Messervey, J. P., 1928: Silica in Nova Scotia; Nova Scotia Department of Public Works and Mines, Pamphlet No. 24.

Sarkar, P. K., 1978: Petrology and geochemistry of the White Rock metavolcanic suite, Yarmouth, Nova Scotia; unpublished Ph.D. thesis, Dalhousie University, Halifax, Nova Scotia; Nova Scotia Department of Mines and Energy, Thesis 319.

Wright, J. D., 1964: Silica, its uses, specifications, and descriptions of deposits in Nova Scotia; Nova Scotia Department of Mines and Energy, Open File Report 087.

Department of Mines and Energy

Honourable Ken Streatch
Minister

John J. Laffin, P. Eng., FEIC
Deputy Minister

Halifax, Nova Scotia
1988

Nova Scotia Department of Mines and Energy, Information Circular No. 14

Canada—Nova Scotia
Mineral Development Agreement

For additional information contact:
Nova Scotia Department of Mines and Energy
1701 Hollis Street
P.O. Box 1087
Halifax, Nova Scotia
B3J 2X1
Telephone: 902-424-4161
Telex: 019-21690
Telecopier: 902-421-1321